Empirical and Simulation Analysis of the Efficiency of Congestion Management across Electricity Markets. The Case of PJM Interconnection and Midwest ISO.

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Overview

Management of transmission congestion across control areas operating within an electrically synchronized interconnection system is a well known problem with a long history and a variety of methods used to address it in real power networks. The problem arises from the fact that generation dispatch decisions made within an individual control area create an impact on power flows across transmission facilities located within other control areas and could negatively impact the economic efficiency of generation dispatch within individual control areas and in a system as a whole.

This problem is also recognized in simulation studies addressing power market analyses and employing production costing simulation tools. These simulation tools are designed to obtain optimal dispatch and generation unit commitment decisions. Analysts relying on such tools face the problem of modelling sub-optimal operations of the market caused by inefficient congestion management across market seams. A widely recognized approach toward modelling these inefficiencies in the use of hurdle rates imposed on power transfers between markets. Definition of these hurdles is often arbitrary and the authors of this paper are aware of no theory to support the assumption that such hurdle rates provide an adequate representation of inefficiency of congestion management.

The first objective of this paper is to report on the results of the empirical and simulation analysis of congestion management practices used between PJM Interconnection (PJM) and Midwest ISO (MISO) electricity markets. It is important to note that congestion management procedures developed between these two markets are thoroughly designed and intend to provide nearly optimal efficiency. The approach taken by PJM and MISO is based on the so called reciprocal flowgates, i.e. transmission constraints significantly affected by generation dispatch decisions in both markets and as a result monitored by both market engines subject to information coordination between two system operators.

The second objective of this paper is to demonstrate the inaccuracy of inter-market hurdle rates to represent inefficiency of congestion management activities across market seams resulting from an inefficient management of reciprocal flowgates and to develop a more accurate modelling approach.

The third objective of this paper is to combine the empirical analysis with the accurate modeling technique and to assess the efficiency of congestion management between PJM and MISO.

Methods

Statistical analysis of market information; illustrative models of linearized optimal power flow; production costing simulations with GE MAPS (General Electric Multi-Area Production Simulator).

Results

Our statistical analysis of market data reported by PJM and MISO indicates significant inefficiencies in congestion management between these two systems. Consideration of illustrative examples involving linearized optimal power flow models demonstrate that the use of simple cross-market trade hurdles does not provide accurate enough representation of inefficient congestion management based on reciprocal flowgates and that a more adequate approach should be based on explicit representation of reciprocal flowgates as monitored by each system operators. Simulations with GE MAPS based on the suggested representation of reciprocal flowgates provide and assessment of economic impact of inefficient congestion management on system-wide production costs and on electricity prices.